BONY SENSIBILITY.[1]

By Philip Coombs Knapp, A.M., M.D.,

of Boston.

CLINICAL INSTRUCTOR IN DISEASES OF THE NERVOUS SYSTEM, HARVARD MEDICAL SCHOOL; PHYSICIAN FOR DISEASES OF THE NERVOUS SYSTEM, BOSTON CITY HOSPITAL.

In his *Sémiologie du Système Nerveux* Dejerine[2] dwells at some length upon the method of detecting the bony sensibility described by his assistant, Egger.[3] Egger found that if a tuning-fork in vibration were placed upon any part of the body where the bones were near the surface, a peculiar feeling of thrill was perceived. If placed on the soft parts, as over the belly of a muscle, this sensation is no longer felt. This sensation is apparently not carried on by the vibrations of the bony structure, but by the intermediary of the nerves, and is not propagated to other parts of the bone unless very strong. Sano[4] suggested the necessity of distinguishing between this thrill and the auditory sensation conducted to the cochlear nerve through the bone, but the two sensations are so absolutely different that the caution seems unnecessary. Dr. C. J. Blake has also suggested, in conversation with a colleague, that this form of sensibility was merely a manifestation of the bony conduction of sound, against which, if further proof were needed than the difference of the two sensations, it would be at once afforded by the fact that in several cases I have found a notable hypesthesia of the ulna when the radius on the same side was normally sensitive.

In point of fact, when the tuning-fork is set in vibration and the base of the fork is applied on any spot where the bone is not covered with much soft tissue, a number of distinct sensations are normally perceived—the sense of contact of the fork, a sensation of cold, the perception of the sound of the fork by the ear, and a peculiar feeling of vibration, the true sensation from the bone, which the average patient likens to an electric shock. Egger states that sometimes, when the true bone sensation is diminished, the application of the vibrating fork may give a sensation of heat, a fact which I have observed in one or two instances.

Through a misunderstanding, when I first began testing the sensibility I believed it necessary to use a large fork of low pitch, as low as A_2, with 26 vibrations a second. This is not adapted, however, for delicate testing, and Egger recommends the tenor C (C_0 with 128 vibrations a second, bass C of Gowers[4]). In this way, by comparing corresponding regions, we can often detect a diminution in the bony sensibility, but even this method fails in the detection of slight defects in sensibility. The best method is to use forks of various pitch. For this purpose a set of five or six C forks is desirable, ranging from contra C (C_2 of 32 vibrations a second) to C in altissimo (C^4 of 2,048 vibrations a second). With diminution of bony sensibility the vibration of the higher-pitched forks is not felt, and in this way we can compare the sensibility of corresponding regions and obtain a relative idea of the diminution.

In normal conditions the sensitiveness of the bone seems to vary merely with the thickness of the soft parts that cover it, or, in other words, it is dependent upon the closeness of contact with the vibrating fork. Other things being equal, we find no variation in sensitiveness between different bones as we do between different areas of skin. Normally vibrations of the treble C fork (C^2, 512 per second) are usually the highest that can be perceived, although I have found some persons who can detect the vibrations of C in alt. (C^3, 1,024 per second, supra-treble C of Gowers). If middle C (C^1, 256 per second) can not be felt it should be regarded as abnormal. Egger has found some cases of bony hypersensitiveness, where C in altissimo (C^4, 2,048 per second) could be felt; and I have also observed this in a few cases.

Clinically the bony sense may be diminished by disease affecting all parts of the nervous system—injury to the peripheral nerves, tabes, syringomyelia, syphilitic spinal paralysis, cerebral hemorrhage and hysteria. Diminution of bony sense does not seem to have any necessary connection with disturbances of other forms of sensibility. I have found it most frequently associated with diminished tactile sensibility, and occupying the same area. In several cases of injury to the ulnar nerve, for example, the bony sensibility was diminished in the phalanges and metacarpals of the ring and little fingers, and along the ulna for a varying distance.

In hemianesthesia from cerebral hemorrhage, with loss of sensibility for pain, touch, temperature, motion, position, localization, and the stereognostic sense, the bony anesthesia followed the typical distribution of the tactile sense, being greatest in the distal portion of the limb, and diminishing upwards towards the trunk.

Although the loss of bony sensibility often coincides with loss of tactile sensibility, yet the two do not necessarily go together. In tabes it often happens that tactile sensibility may be preserved, except perhaps in some small area, while there is extensive loss of bony sensibility. I have also found this to be true in syphilitic spinal paralysis. In one case the sensibility to touch and pain was perfect, except for a small area on the abdomen; the localizing power was good, but the sense of position and movement were much impaired, and the bony sensibility was much diminished below the waist, especially in the pelvis and thigh bones.

On the other hand there is no necessary relation between the bony sensibility and the other forms of deep sensibility. In a case of paresis of the right leg, following a fracture of the skull, with injury to the brain substance, the sensibility to touch and pain and the bony sensibility were normal, but there was great impairment of the sense of motion, position and localization. Our tests for the various forms of muscular sense are still too unsatisfactory to enable us to determine whether loss of bony sensibility may exist when the muscular sense is perfectly normal, but the case just cited shows that bony sensibility may be normal when the muscular sense is greatly impaired.

On the whole, therefore, bony sensibility seems to be an independent form of sensibility, having no necessary relation to other forms of sensibility. The course of the fibers that convey this form of sensibility is uncertain. The sensibility is conveyed to the cord by the peripheral nerves, as the cases cited show. Egger thinks that the fibers then ascend uncrossed in the gray matter. He has found bony anesthesia on the same side as loss of muscular sense in Brown-Séquard's paralysis, and he thinks that the existence of bony anesthesia in syringomyelia indicates that the sensory tract is in the gray matter. This seems a little doubtful, as bony anesthesia may exist in a great variety of diseases of the cord.

The great variety of affections in which bony anesthesia may occur makes its clinical significance rather slight. The chief significance of the symptom seems to be that it throws some new light upon the development of arthropathies and spontaneous fractures in tabes and syringomyelia, as showing the sensory condition of the bones and their insensibility to injury, and also as indicating that one more sensory factor must be taken into account in studying the physiology of coördination of movements.

---

[1] Read by title at the meeting of the American Neurological Association, May 12, 13 and 14, 1903.

[2] Bouchard. Traitè de Pathologie Générale, v. 884.

[3] Journal de Physiologie et de Pathologie Générale, i, 511, May, 1899; Revue Neurologique, x, 549, June 30, 1902.

[4] Journal de Neurologie, N. F. 1901.